Upconversion luminescence of lanthanide-doped $CaMoO_4$/ $CaWO_4$ 3D microstructure materials

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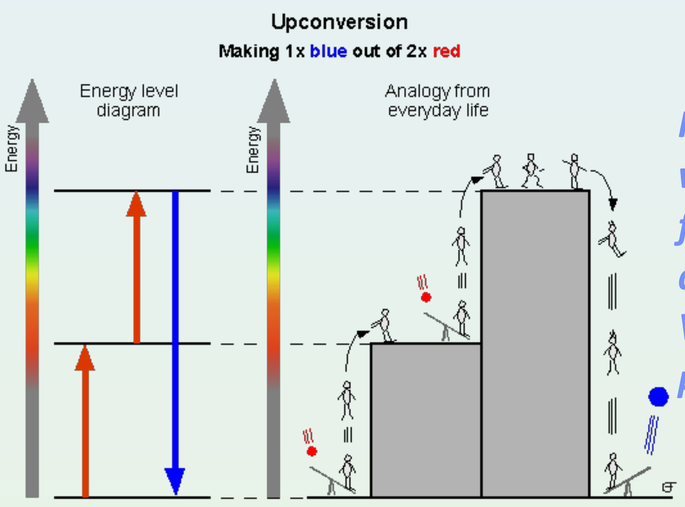
Upconversion



Photoexcitation at a certain wavelength in the NIR followed by luminescence at a shorter wavelength in the VIS is called NIR to VIS photon upconversion.

This is a rather unusual process since low energy photons are "converted" to higher energy photons. At least two NIR photons are required to generate one VIS photon.

Method

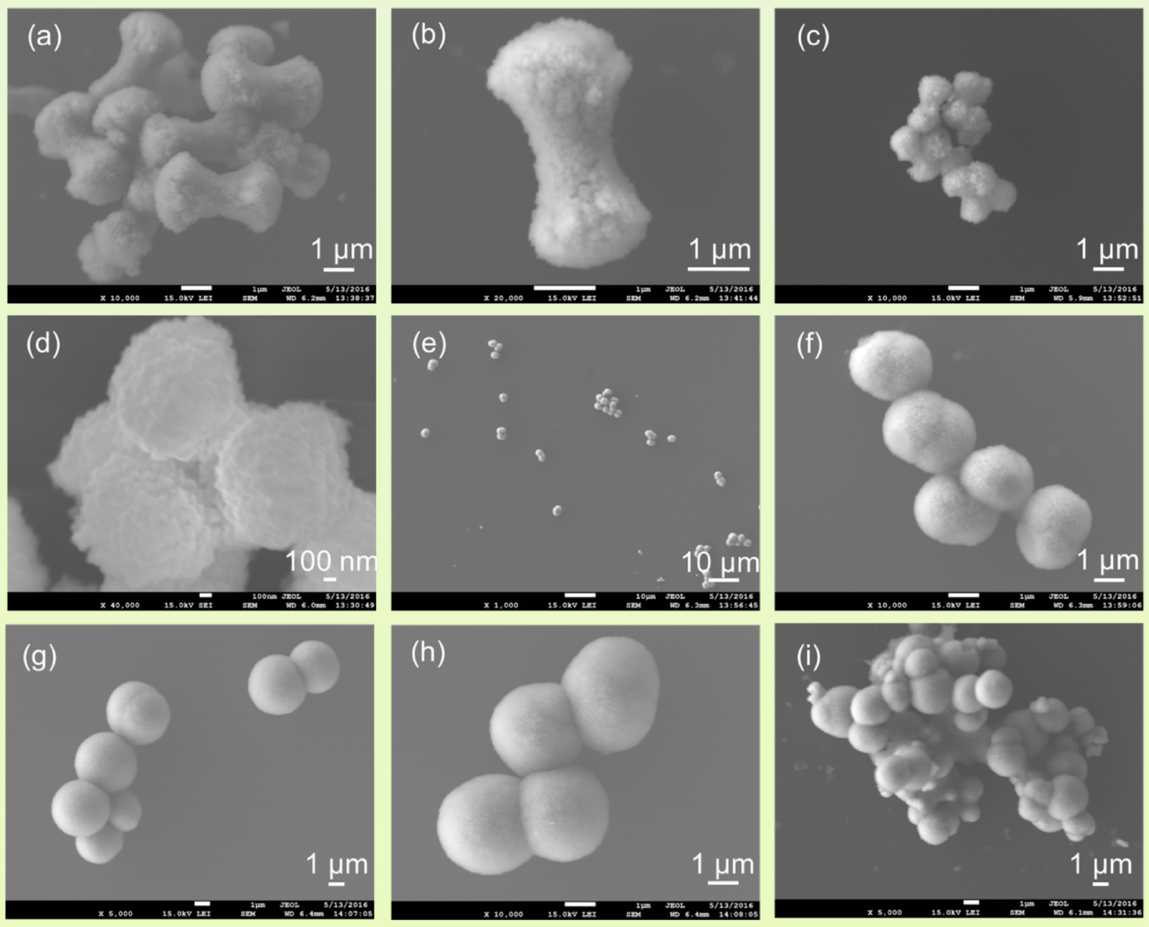
hydrothermal

concentration ***composition***

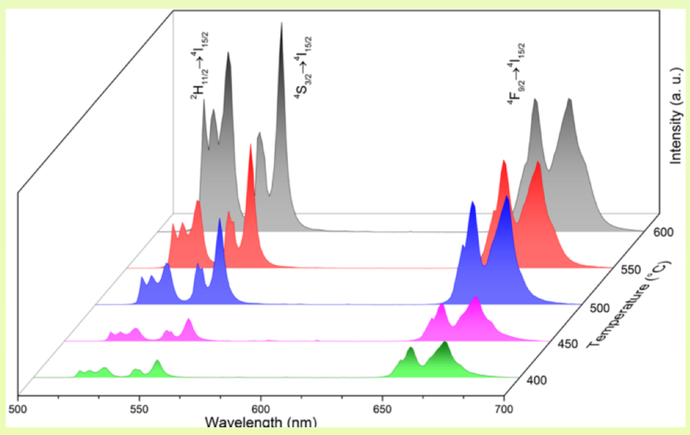
$CaMoO_4$: Er^{3+}, Yb^{3+} — 0.5 mmol, 1.0 mmol, 2.5 mmol, 5 mmol, 10 mmol — precursors in 40 mL water

$CaMo_xW_{1-x}O_4$: Er^{3+}, Yb^{3+} x=(0, 0.2, 0.5, 0.8, 1)

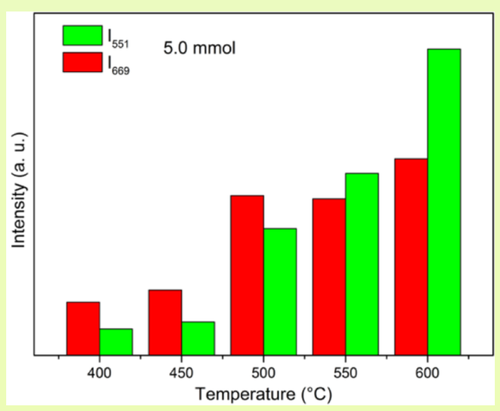
Different Concentration



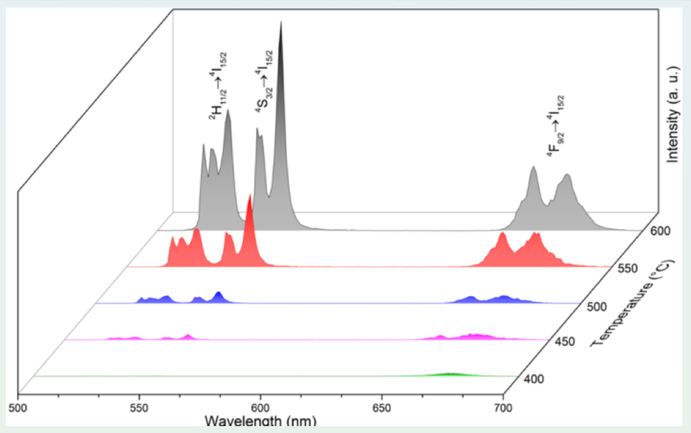
SEM images of (a-b) 0.5 mmol $CaWO_4$, (c-d) 1.0 mmol $CaWO_4$, (e-f) 2.5 mmol $CaWO_4$, (g-h) 5 mmol $CaWO_4$, (i) 10 mmol $CaWO_4$.



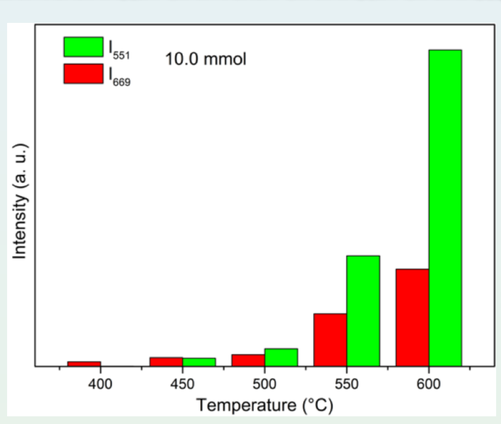
5 mmol $CaWO_4$: Er^{3+}, Yb^{3+}



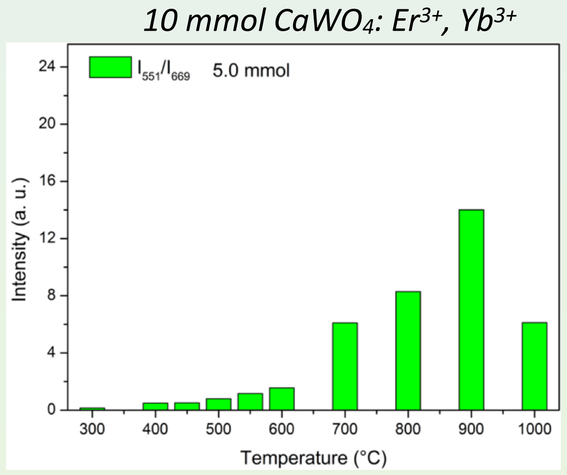
400 °C to 600 °C (50 °C step)



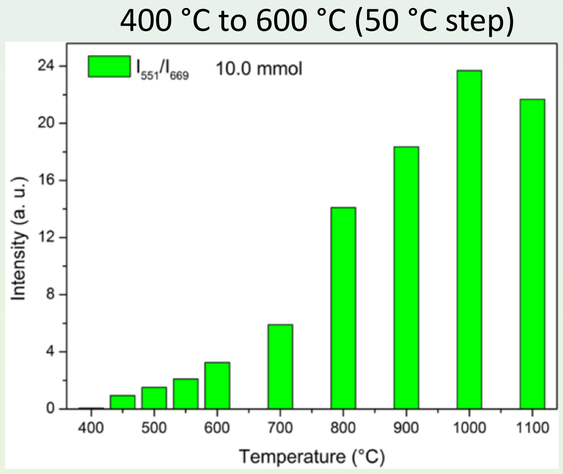
10 mmol $CaWO_4$: Er^{3+}, Yb^{3+}



400 °C to 600 °C (50 °C step)

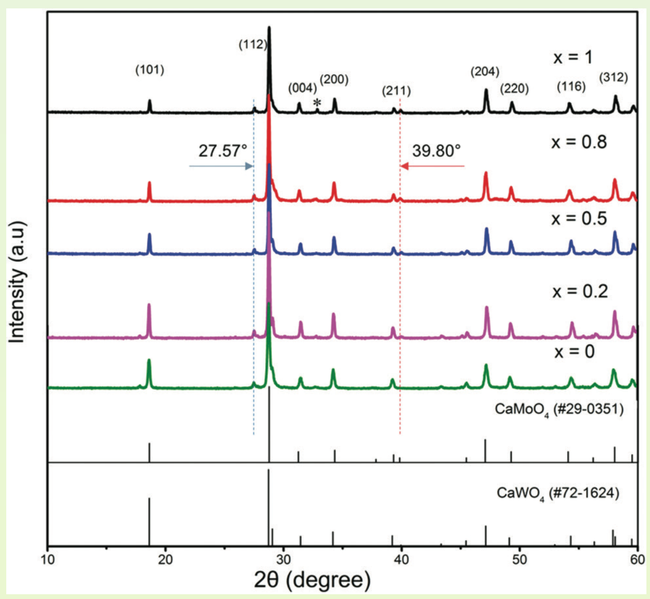


5 mmol $CaWO_4$: Er^{3+}, Yb^{3+} heat treated from 300-1000 °C



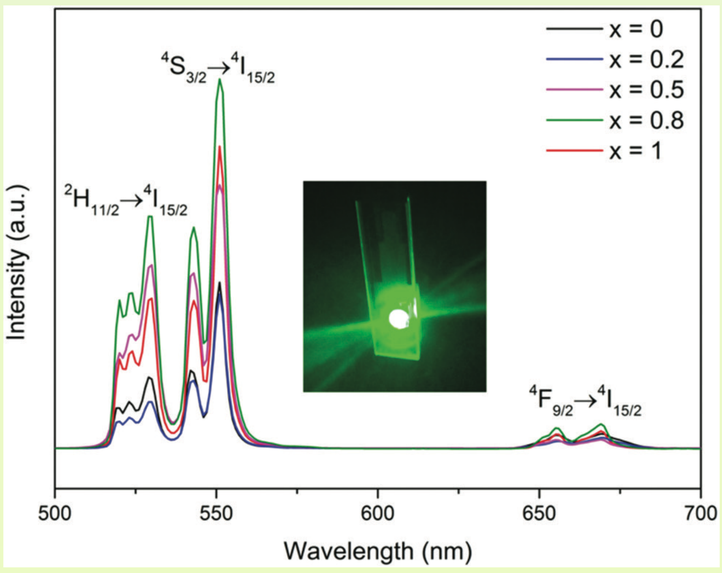
10 mmol $CaWO_4$: Er^{3+}, Yb^{3+} heat treated from 400-1100 °C

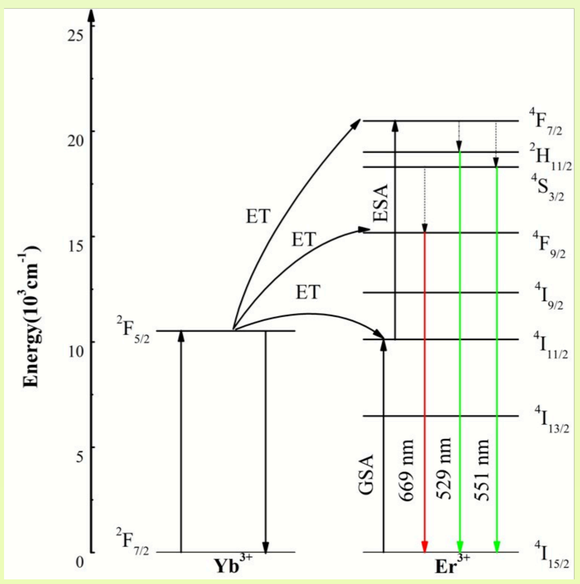
Different Composition



XRD patterns of $CaMo_xW_{1-x}O_4$: Er^{3+}, Yb^{3+} upconversion particles.

PL emission spectra of $CaMo_xW_{1-x}O_4$: Er^{3+}, Yb^{3+} upconversion particles under 975 nm excitation.





Schematic energy level diagram of Er^{3+} and Yb^{3+} in $CaMoO_4$-$CaWO_4$ and possible upconversion mechanisms under excitation at 975 nm. (ET is energy transfer, GSA is ground state absorption and ESA is excited state absorption.)

References

1. A. M. Kaczmarek, R. Van Deun, *Chem. Soc. Rev.*, **2013**, 42, 8835-8848.
2. J. Liu, A. M. Kaczmarek, J. Billet, I. Van Driessche, R. Van Deun, *Dalton Trans.*, **2016**, 45, 12094-12102.